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SITE CHARACTERIZATION STUDY AND
GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

Report to

GNB BATTERIES, INC.
St. Paul, Minnesota

By

PROFESSIONAL SERVICE INDUSTRIES, INC.
NATIONAL SOIL SERVICES DIVISION
Consulting Engineers
Dallas, Texas

December, 1984

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Professional Service Industries, Inc.
National Soil Services Division

December 18, 1984
Job No. 342-45301

GNB Batteries, Inc.
Automotive Battery Division
P. O. Box 64140
St. Paul, Minnesota 55164

Attention: Mr. Everett C. Milton
Manager, Facilities Engineering

SITE CHARACTERIZATION STUDY AND
GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC. - KANKAKEE, ILLINOIS

Gentlemen:

Presented herein is the report of our geotechnical and environmental studies for the above-referenced location. This report includes a general description of subsurface conditions, our interpretation of the groundwater gradient across the site, results of chemical analyses on soil and water samples obtained at widely separated locations and differing depths and our interpretation of the results. Recommendations are presented for a more in depth study and assessment of potential groundwater contamination. These studies were conducted in general accordance with our proposal PN 758 dated July 27, 1984 as authorized by Mr. Everett C. Milton on July 31, 1984 with Purchase Order No. 57059690.

We appreciate the opportunity to have performed this study. Should you have any questions or need additional assistance, please call.

Very truly yours,

PSI/NATIONAL SOIL SERVICES DIVISION

William Prikryl, P. E.
Project Engineer

WP/gt

Copies submitted: 3

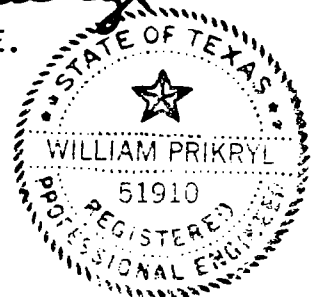


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PART I - INTRODUCTION

GENERAL

The manufacture of industrial grade lead-acid batteries has been conducted on site for a period in excess of 33 years. During this period, the facilities have been expanded to allow for increased production. The existing fence line is believed to represent the original fence line and it is believed that all operations have been confined to the area inside the fenced area.

Waste materials including demolition rubble, worn out equipment and certain by-products of the manufacturing processes have been stored on site in waste piles and temporary storage areas generally located on the east, north and west sides of the facility. Racks, bins and other obsolete equipment which have been contaminated by lead oxide are stored in exposed areas and generally unprotected from the effects of weathering. Surface runoff from these storage areas is not prevented from entering natural drainage channels which flow toward the north where they enter a drainage channel along the northern property boundary that flows toward the east.

A preliminary survey of soil and surface water quality across the enclosed area and surface drainage channels was completed on June 26, 1984. Results of laboratory analyses indicated that, with few exceptions, total lead in the surficial soils is very high. Total lead in water samples obtained in three of four locations was less than the level allowed in the National Interim Primary Drinking Water Standards. However, water samples obtained from an abandoned manhole located outside the northeast corner of the fence enclosed area contained elevated concentrations of lead, but was full of sediment and

was not flowing. Leachable lead, determined by the U. S. EPA extraction procedure (EP), in eight soil samples which contained the highest observed total lead concentrations, exceeded the toxicity criteria which establishes the classification of the soil as hazardous. The pH levels were evaluated for both soil and water samples and were determined to be essentially neutral.

The results of the preliminary survey were reported July 16, 1984 and immediately triggered the request for a more detailed in depth study of not only the surficial soils but also subsurface conditions and groundwater. This study represents the first look at the overall site for potential contamination levels.

PURPOSE AND SCOPE

The site assessment studies have included 18 soil sample borings, the installation of eight piezometers, and four field packer tests to evaluate the in-place permeability of the underlying rock formation. Samples of each soil formation encountered in the borings have been evaluated for concentrations of lead. Groundwater samples were evaluated for the concentration or level of each of the following:

1. Total Dissolved Solids
2. pH
3. Specific Conductance
4. Chloride
5. Nitrate
6. Sulfate
7. Lead

Preliminary results of these analyses were used to assess the extent and degree of contaminant levels on site.

PART II - FIELD INVESTIGATION

SAMPLE BORINGS

Subsurface conditions were defined by 18 soil and rock sample borings identified as B-1 through B-18 and located as shown on the Plan of Borings, Plate 2, in the illustrations section of this report. Soil and rock formations encountered are described on the boring logs, Plates 3 through 20. Keys to descriptive terms and symbols used on the logs are presented on Plates 21 and 22. Borings were advanced using a hollow stem auger. Undisturbed samples were obtained with thin-walled Shelby tube samplers where possible, or by use of a split-barrel sampler and ASTM D-1586 Standard Penetration Test procedures where subsurface conditions required. Samples were obtained continuously from the surface to the depth of the underlying rock formation. Rock formations were cored in four locations using an NX-size, double-tube core barrel capable of recovering rock cores 1.875 inches in diameter. Standard field drilling and sampling procedures are described in the appendix.

PIEZOMETER INSTALLATIONS

Eight piezometers were installed in boreholes B-4, 5, 6, 9, 11, 14, 15 and 17, as shown on the attached Plan of Borings and Piezometer Locations, Plate 2. Piezometers were installed to an average depth of 24 feet in borings B-5, 6, 11 and 15, while all other piezometers were installed to an average depth of 12 feet. Static groundwater readings are presented in the lower right-hand corner on the boring logs. The static groundwater levels were used to construct our interpretation of the groundwater contours as presented on

Plate 29. Elevations are based on a survey of all boring locations completed by Tyson Engineering, Inc., on October 16, 1984. Elevations include the top of ground and the static water level at each boring and piezometer location and are presented on Plate 29.

PACKER TESTS

Field packer tests were conducted in the limestone formation underlying the site in borings B-5, 6, 11 and 15. The packer test is an in-situ permeability determination which utilizes an inflatable packer in the open borehole to allow the introduction of water under pressure. The rate at which the formation accepts the water is measured and empirically derived relationships between the constant flow rate, the length and radius of that portion of the hole tested, and the differential head of water applied are used to determine the permeability (Ref: U.S. Department of the Interior, Bureau of Reclamation, Earth Manual, Second Edition, 1974, pp. 573-578). Results of the four packer tests are presented on the boring logs at the corresponding depth of the test and are summarized on Plate 31.

PART III - LABORATORY INVESTIGATION

SOIL ANALYSES

Laboratory tests included chemical analyses of soil samples obtained from various depths at each boring location to determine the concentration of total lead and the EP toxicity for lead in each sample tested. Results are summarized on the testing laboratory's reports, Plates 26, 27 and 28. Laboratory test procedures and methods were conducted in accordance with the American Public Health Association, Standard Methods, 15th Edition, and current U.S. EPA methods. All laboratory testing was accomplished by Suburban Laboratories, Inc., 4140 Litt Drive, Hillside, Illinois.

GROUNDWATER ANALYSES

Groundwater samples were obtained from each piezometer installation following development of the natural formation and prepumping to remove all non-representative water. Laboratory tests included chemical analyses of each sample to determine the concentration or level of each of the following parameters:

1. Dissolved Solids
2. pH
3. Specific Conductance
4. Chloride
5. Nitrate
6. Sulfate
7. Lead

Results are summarized on the testing laboratory's reports, Plates 23, 24 and 25. These tests were performed in accordance with the American Public Health Association Standard Methods, 15th Edition, and current U.S. EPA methods. All laboratory testing was accomplished by Suburban Laboratories, Inc., 4140 Litt Drive, Hillside, Illinois.

PART IV - SITE AND SUBSURFACE CONDITIONS

TOPOGRAPHY

The project site is located in northeastern Illinois on the west side of the community of Kankakee. The Kankakee River flows north-northwest approximately 1.3 miles east of the site. The normal river pool elevation, Elev 595, is approximately 30 feet below the surface elevation at the plant site. However, surface gradients are very gentle throughout the site and surrounding area. Topographic maps of the surrounding area indicate a gentle surface gradient of generally north to south outside the plant area. Northeastern Illinois is near the center of the physiographic Central Lowland Province, a glaciated lowland with generally low relief. A low north-south-trending drainage divide is present a few miles west of Lake Michigan. West of this divide, including the plant site, drainage is into the Mississippi River System, of which the Kankakee River is part.

GEOLOGY

Throughout most of northeastern Illinois, unconsolidated deposits overlies a bedrock formation. These unconsolidated deposits range from approximately one to more than 400 feet thick and include recent and glacial deposits. The major unconsolidated deposit is glacial till, an unsorted mixture of clay, silt, sand, and boulders deposited directly from the glacial ice. The uppermost bedrock is fractured dolomite of Silurian age and is a major aquifer in the region. The bedrock generally dips eastward at ten to 15 feet per mile.

HYDROLOGY

Groundwater is an important resource in northeastern Illinois. There are three major sources of groundwater in northeastern Illinois. These include a deep bedrock aquifer system, a shallow bedrock aquifer system, and the glacial drift aquifer system. The glacial drift aquifer system and the shallow bedrock aquifer system are most susceptible to pollution from solid waste disposal due to being at or near the surface. Susceptibility of the shallow bedrock aquifer system is further increased because it is composed of fractured rocks. Recharge to the glacial drift and shallow bedrock aquifer systems is generally derived from precipitation or surface water. The top of the zone of saturation (water table) is generally within five to ten feet of the ground surface.

PART V - ANALYSES OF RESULTS

SOIL CONTAMINATION

Total lead and leachable lead concentrations were determined for 46 soil samples obtained at depths ranging from 2.5 to ten (10.0) feet in 18 boring locations across the approximately 30-acre site. Values obtained, as presented on Plates 26 through 28, indicate concentrations of total lead ranging from just over 13 parts per million (ppm) to approximately 36,000 ppm. Leachable lead was determined by the U.S. EPA extraction procedure. These values range from less than 0.10 ppm to just under 45 ppm. In most locations sampled, the total and leachable lead concentrations tend to decrease with depth, although, there are exceptions.

Analyses of agricultural soils by W. H. Allaway¹ indicates that lead occurs naturally in concentrations ranging from two (2) to 200 ppm. The mean ambient background level for lead in soils in the eastern United States has been taken as 14 ppm² by the U.S. Environmental Protection Agency (Reference for East/West Division is the 97°W longitude line).

Using these values as guidelines, several conclusions can be drawn from the total lead concentrations observed at the Kankakee, Illinois site. Almost seventy percent of the samples tested contained less than 200 ppm total lead; however, only one sample contained less than 14 ppm. Of the remaining samples, only four failed to pass the U.S. EPA EP Toxicity Test and may be classified as hazardous.

-
1. W. H. Allaway, Advanced Agronomy, 20:235-271 (1968).
 2. Geological Survey Professional Paper 574F (1975).

These include the samples obtained at 2.5 feet in borings B-10 and B-11, and the samples obtained at 5.0 feet and 10.0 feet in boring B-6. All other samples passed the EP Toxicity Test.

The average concentration of total lead in soil samples obtained on site outside the fence enclosed area was observed to be 46.7 ppm, regardless of sample depth and ranged from 13.1 to 188.0 ppm. The total lead concentration observed in soil samples obtained inside the fence enclosed area are too variable to average meaningfully. However, it was noticed that concentrations were highest in samples obtained in the northern half of the fence enclosed area and the average of all samples obtained in the southern (front) half of the fence enclosed area is 141.1 ppm ranging from 32.0 to 626.0 ppm.

GROUNDWATER QUALITY

Results of groundwater samples obtained from each of eight piezometers installed during this study are presented on Plates 23 through 25. Results of a survey of the piezometer locations and static groundwater levels obtained several weeks following installation were used to aid in the interpretation of the groundwater gradients across the site. Our interpretation of the groundwater gradients across the site is presented on Plate 29. This interpretation indicates a gradient of approximately five feet in 800 feet (0.625%) flowing from north-northwest to south-southeast.

Based on the assumption that our interpretation of the groundwater gradient is correct, it is our belief that piezometers installed in borings B-9, 11, 15 and 17 are located upgradient to the waste management area. However, the piezometers in borings B-9 and B-11 were installed in areas with observed high

levels of contamination. Therefore, it is our opinion that only the groundwater samples obtained in piezometers installed in borings B-15 and B-17 are representative of the upgradient groundwater quality. Results of samples obtained in borings B-15 and B-17 indicate the following average quality:

pH	7.2
Specific Conductance	975 umhos/cm
Chloride	114 mg/l
Nitrate	0.68 mg/l
Sulfate	172 mg/l
Lead	<0.001 mg/l

Groundwater samples obtained in piezometers installed in borings B-4, 5, and 14 should likewise be representative of downgradient (or impacted) quality. Results of samples obtained in borings B-4, 5 and 14 indicate the following average quality:

pH	6.8
Specific Conductance	1283 umhos/cm
Chloride	240 mg/l
Nitrate	1.71 mg/l
Sulfate	323 mg/l
Lead	6.97 mg/l

From these comparisons, it is possible that contaminants have entered the groundwater environment. Further, it is noted that limited groundwater data obtained from piezometers B-4, 6 and 9 suggest lead concentrations above the U.S. EPA EP Toxicity Test criteria for classification as hazardous. Also, there appears to be significantly elevated levels of sulfate in the locations of borings B-5 and B-6.

PART IV - RECOMMENDATIONS

GENERAL

Based on the results of our limited field and laboratory studies, site cleanup and/or containment measures may be required in order to bring the plant site into compliance with applicable State of Illinois environmental protection laws. In general, the results indicate a need for additional groundwater quality assessment studies to further define the extent and concentration of contaminants that may be present in the groundwater environment.

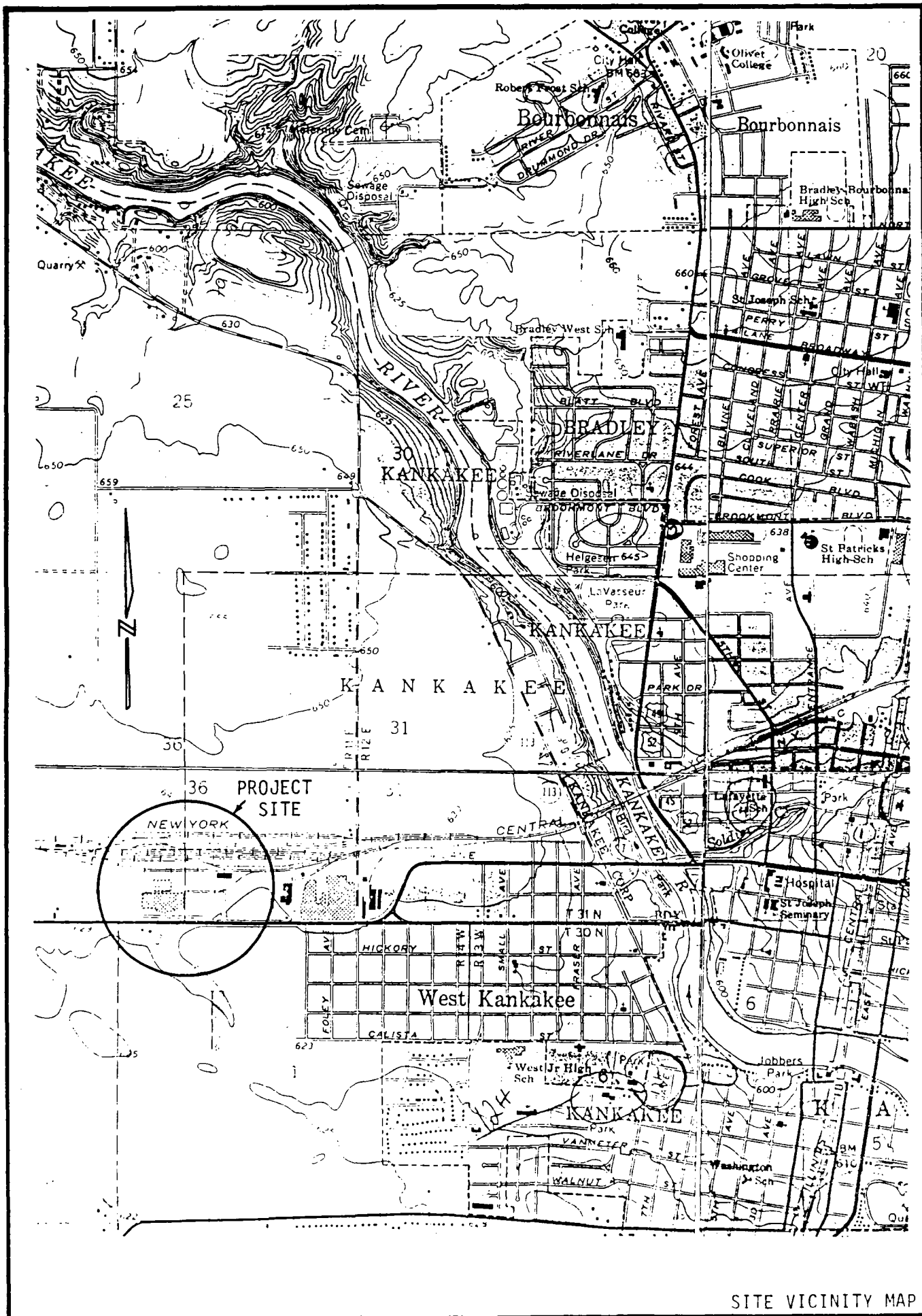
The State of Illinois Rules and Regulations, dated March 1, 1984, entitled, Title 35: Environmental Protection, Subtitle G: Waste Disposal, Chapter I: Pollution Control Board, and Subchapter a: General Provisions, Part 700: "Outline of Waste Disposal Regulations", contains specific information for generators of hazardous wastes, with particular attention to permits, operating requirements and manifests. Application for an identification number with the U.S. EPA should be made in accordance with EPA notification procedures (45 Federal Register 12746). Part 722 of the above Title 35 contains standards applicable to generators of hazardous waste and provides guidance for other applicable provisions and requirements. Part 724 of the above title, entitled "Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities", Subpart F, should be consulted for groundwater protection requirements; Subpart G should be consulted for closure and post-closure requirements; Subpart L should be consulted for waste pile requirements; and, Subpart N should be consulted for landfill requirements.

GROUNDWATER QUALITY ASSESSMENT

Additional groundwater quality assessment studies will be required in order to determine the need for further actions and to help define the extent and concentration of possible contaminant migration. Based on our interpretation of the groundwater gradient through the site, a minimum of one additional upgradient and three additional downgradient monitor wells should be installed to provide reasonable assurance that statistically significant concentrations of potential hazardous waste or hazardous waste constituents originating from the regulated unit will be intercepted by the point of compliance. The point of compliance will be established by both the physical limits of the waste management area and the groundwater gradient through the regulated unit. Monitor wells must penetrate a sufficient depth to yield groundwater samples from the uppermost aquifer both up and downgradient of the regulated unit. Details of a typical proposed well are shown on Plate 30.

Existing piezometers and new monitor wells should be pumped until only clear groundwater is removed. At least an equivalent of five volumes of water contained within the sand filter pack and well casing should be evacuated prior to sampling. Duplicate samples should be obtained and sent to two different independent laboratories for evaluation. Results should be compared and, if within the same order of magnitude, averaged. Significantly dissimilar results should be discarded only after evaluating both laboratories and determining that both used proper methods and procedures. Additional sampling should be conducted until at least three such samples are obtained. A minimum interval of time equivalent to at least 30 days should be allowed between sampling periods in order to allow time for equilibration to occur between the zone of influence for each well and the surrounding groundwater environment. Results of the assessment study should be indicative of the quality of groundwater both before and after impact by on-site conditions.



I L L U S T R A T I O N S

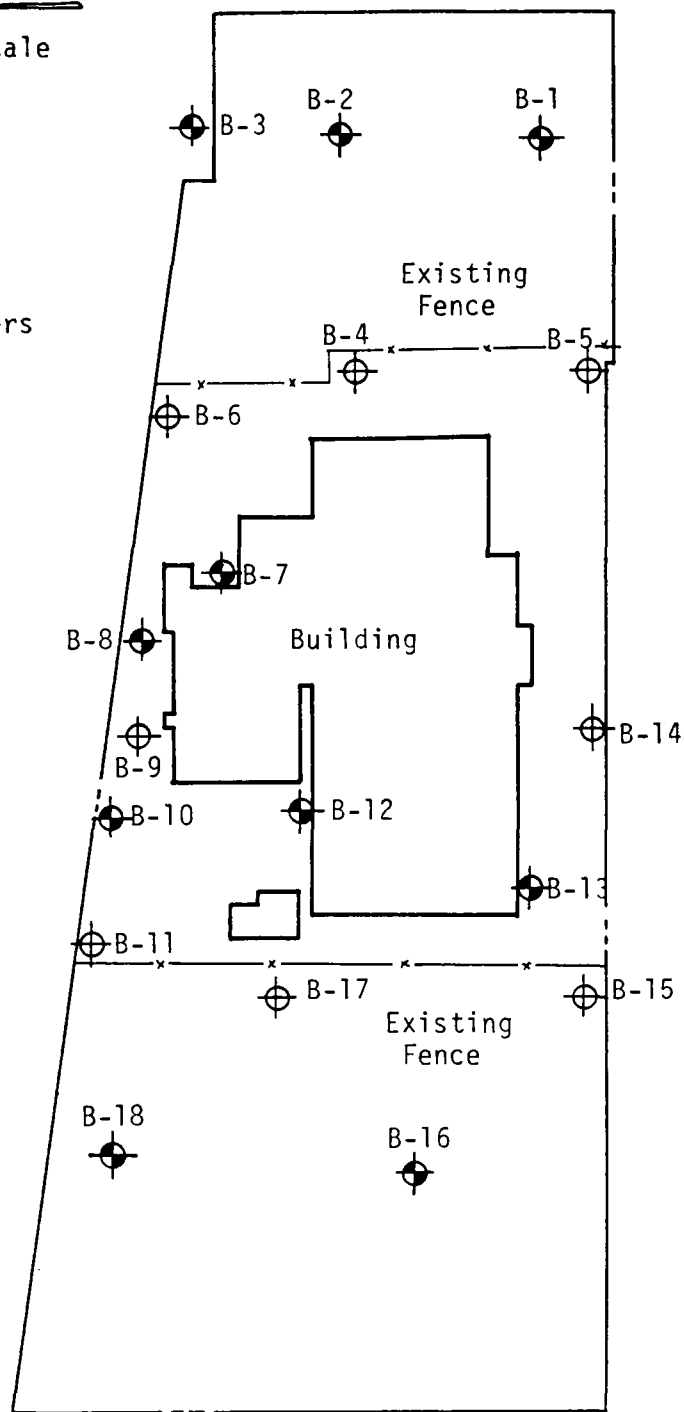


SITE VICINITY MAP

Not to Scale

Legend

-  Borings
-  Piezometers



PLAN OF BORINGS AND
PIEZOMETER LOCATIONS

LOG OF BORING NO. B-1

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Medium dense brown fine to medium gravel	28								
				12								
			(GP)									
5			Firm brown and gray clay w/trace of sand	8								
			(CL) 50/0"									
			Weathered limestone									
10												
15												
20												
25												
30												
35												

COMPLETION DEPTH: 10.0'

DEPTH TO WATER: 7.5'

DATE: 8/28/84

DATE: 8/28/84

LOG OF BORING NO. B-2

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ. FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Stiff gray, brown and black sandy clay, w/sand and brick	15								
			(Fill)	12								
			Stiff brown and gray sandy clay (CL)	11								
5			Stiff gray sandy clay, w/trace of organics (CL)									
			Weathered limestone	88								
10				50/8" seat								
15												
20												
25												
30												
35												

COMPLETION DEPTH: 11.0'

DEPTH TO WATER: 7.5'

DATE: 8/21/84

DATE: 8/21/84

LOG OF BORING NO. B-3

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ. FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Very stiff brown to black silty clay, w/sand and gravel	24								
				9								
			-soft (Fill)	3								
5			Soft gray sandy clay, w/trace of organics									
			(CL)									
			Dense light brown sand, w/gravel	38								
10												
			-very dense	92/10"								
			(SM-SP)									
15			Weathered limestone, w/trace of clay	50/5"								
				seat								
20												
25												
30												
35												

COMPLETION DEPTH: 16.5'

DEPTH TO WATER: 8.0'

DATE: 8/21/84

DATE: 8/21/84

LOG OF BORING NO. B-4

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Loose to medium dense fine gravel, w/trace of sand	8								
				12								
5			(Fill) (GP)	9								
			Weathered limestone, w/sand and brown clay	50/8"								
				50/2"								
10			Note: Piezometer installed in boring.									
15												
20												
25												
30												
35												

COMPLETION DEPTH: 8.5'

DEPTH TO WATER: 7.0'

DATE: 8/27/84

DATE: 8/27/84

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

[illegible]

DEPTH TO WATER: 10.0'
DATE: 9/7/84

LOG OF BORING NO. B-6

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon/Core Sample LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	CORE RECOVERY %	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Stiff brown fine sandy gravel and clay (Fill)	16								
			Firm dark brown sandy clay, w/some sand and gravel (CL)	5								
5			Soft brownish-gray mottled silty clay, w/trace of sand (CL)	3								
			Broken and weathered limestone	50/5.5"								
10				86/11.5"								
15				50/3" seat								
			-unweathered	50/1" seat								
20				60								
									$K_h = 4.66 \times 10^{-4}$ cm/sec			
25			Note: Piezometer installed in boring.									
30												
35												

COMPLETION DEPTH: 22.0'

DEPTH TO WATER: 5.0'

DATE: 9/10/84

DATE: 9/10/84

LOG OF BORING NO. B-7

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ. FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Very stiff brown sandy clay, w/brick and gravel	22								
				25								
			(Fill)									
5			Stiff brown clay, w/trace of gray clay, w/trace of silt and sand	12								
			(CL) seat	50/4"								
			Weathered limestone									
10												
15												
20												
25												
30												
35												

COMPLETION DEPTH: 10.0'

DEPTH TO WATER: 4.0'

DATE: 8/21/84

DATE: 8/21/84

LOG OF BORING NO.B-8

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Medium dense crushed rock and gravel (Fill) (GP)	22 5								
5			Soft brown and gray clay, slightly sandy, w/fine to medium gravel below 4.5' (CL)	4								
			Weathered limestone	50/5"								
10			-unweathered at 10.0'									
15												
20												
25												
30												
35												

COMPLETION DEPTH: 10.0'

DEPTH TO WATER: 3.0'

DATE: 8/21/84

DATE: 8/21/84

LOG OF BORING NO. B-9

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ. FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Firm brown and gray clay, w/roots in upper 2"	4								
			(CH)	6								
5			Firm gray silty clay	7								
			(CL)									
10			Weathered limestone, loose from 8.5-10.0'	50/4"								
				50/5"								
15			Note: Piezometer installed in boring.									
20												
25												
30												
35												

COMPLETION DEPTH: 13.0'
DATE: 8/23/84

DEPTH TO WATER: 3.0'
DATE: 8/23/84

LOG OF BORING NO.B-10

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Gravel, w/brick rubble, glass and cinders	15								
				12								
			(Fill)	90/8"								
5			Brown weathered limestone, w/coarse sand									
				50/4"								
			-unweathered at 9.0'	seat								
10												
15												
20												
25												
30												
35												

COMPLETION DEPTH: 9.0'

DEPTH TO WATER: 3.5'

DATE: 8/24/84

DATE: 8/24/84

LOG OF BORING NO.B-11

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon/Core Sample LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	CORE RECOVERY%	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Stiff brown silty clay, w/gravelly sand and rubble, rubber and brick (Fill)	8								
				14								
5			Firm black clay, w/trace of sand and gravel (CH)	7								
			Weathered limestone	50/3" seat								
10				50/3" seat								
15				50/3" seat								
20				50/1" seat								
				50/0" seat								
25				100								
									$K_f = 2.77 \times 10^{-5} \text{ cm/sec}$			
			Note: Piezometer installed in boring.									
30												
35												

COMPLETION DEPTH: 26.5'

DATE: 9/11/84

DEPTH TO WATER: 6.0'

DATE: 9/11/84

LOG OF BORING NO. B-12
 SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
 GNB BATTERIES, INC.
 KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Medium dense gray and yellow sand w/gravel (SP)	14								
			Firm grayish-brown clay (CH)	5								
			Weathered limestone	52/11"								
5				50/3"								
				50/5.5"								
10												
15												
20												
25												
30												
35												

COMPLETION DEPTH: 8.0'

DEPTH TO WATER: 3.0'

DATE: 8/24/84

DATE: 8/24/84

LOG OF BORING NO. B-13

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Dense fine to medium gravel, w/4" topsoil (Fill)	37								
			Medium dense, medium to large gravel, w/sand (Fill) (GP)	18								
5			Medium dense, medium to large gravel, w/brown clay and sand (GP)	10								
			Weathered limestone, w/trace of sand	50/0"								
10												
15												
20												
25												
30												
35												

COMPLETION DEPTH: 10.0'

DEPTH TO WATER: 5.0'

DATE: 8/27/84

DATE: 8/27/84

LOG OF BORING NO. B-14
 SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
 GNB BATTERIES, INC.
 KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION ELEVATION:	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ. FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			Very stiff black topsoil (CL)	17								
			Loose brown sand, w/fine gravel and trace of black clay (SP)	8								
5			Stiff gray clay, w/trace of black clay and sand (CH)	10								
			Weathered limestone	48								
10				50/3"								
15			Note: Piezometer installed in boring.									
20												
25												
30												
35												

COMPLETION DEPTH: 13.5'

DEPTH TO WATER: 11.0'

DATE: 8/27/84

DATE: 8/27/84

LOG OF BORING NO. B-15

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon/Core Sample LOCATION: See Plan of Borings, Plate 1

DEPTH, FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	CORE RECOVERY %	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Very stiff dark brown sandy clay (CL)	20								
			Stiff grayish-brown to dark brown silty clay, w/sand	12								
5			(CL)	12								
			Weathered limestone	72								
10				41								
15				50/4" seat								
20				50/3" seat								
				50/0" seat								
				100								
25									K_f = impermeable			
			Note: Piezometer installed in boring.									
30												
35												

COMPLETION DEPTH: 25.8'

DATE: 9/6/84

DEPTH TO WATER: 12.0'

DATE: 9/6/84

LOG OF BORING NO. B-16
 SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
 GNB BATTERIES, INC.
 KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Firm black topsoil (CL)	8								
			Firm gray clay, w/trace of brown clay and sand (CL)	7								
5			Dense fine to medium gravel, w/sand (SP-GP)	66								
10			Weathered limestone	21								
15				50/4"								
20												
25												
30												
35												

COMPLETION DEPTH: 15.0'

DEPTH TO WATER: 4.0'

DATE: 8/27/84

DATE: 8/27/84

LOG OF BORING NO. B-17
 SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
 GNB BATTERIES, INC.
 KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Firm black topsoil (CL)	7								
			Stiff brown clay, w/trace of sand and black clay (CH)	14								
5			Weathered limestone, w/sand and trace of gray clay	50/5.5"								
				seat								
10				50/5"								
				seat								
15			Note: Piezometer installed in boring.									
20												
25												
30												
35												

COMPLETION DEPTH: 13.5'

DEPTH TO WATER: 5.0'

DATE: 8/28/84

DATE: 8/28/84

LOG OF BORING NO. B-18

SITE CHARACTERIZATION STUDY AND GROUNDWATER QUALITY ASSESSMENT PLAN
GNB BATTERIES, INC.
KANKAKEE, ILLINOIS

TYPE BORING: Split Spoon Sample

LOCATION: See Plan of Borings, Plate 1

DEPTH. FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS PER FT.	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH IN TONS/SQ FT.			UNIT DRY WT. LBS./CU. FT.
									0.5	1.0	1.5	
			ELEVATION:									
			Black topsoil (CL)	9								
			Loose brown sand (SP-SM)									
			Soft brown and gray clay, w/trace of sand and silt (CL)	3								
5			Dense fine to medium gravel, w/sand;w/trace of gray clay (GP-SP)	43								
			50/0"									
			Weathered limestone seat									
10												
15												
20												
25												
30												
35												

COMPLETION DEPTH: 9.0'

DEPTH TO WATER: 5.0'

DATE: 8/28/84

DATE: 8/28/84

KEY TO SOIL CLASSIFICATIONS AND SYMBOLS

SOIL TYPE				SAMPLE TYPE				
Gravel	Sand	Silt	Clay	Undisturbed		Disturbed		
Gravelly	Sandy	Silty	Clayey	Pitcher Barrel	Shelby Tube	Auger	Split Spoon	No Recovery

Predominant type shown heavy

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS

(Major portion retained on No. 200 sieve)

Includes (1) clean gravels and sands described as fine, medium or coarse, depending on distribution of grain sizes and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests or estimated from resistance to sampler penetration.

Penetration Resistance Blows/Foot**	Descriptive Term	Relative Density*
0 - 10	Loose	0 to 40%
10 - 30	Medium dense	40 to 70%
30 - 50	Dense	70 to 90%
Over 50	Very dense	90 to 100%

* From tests on undisturbed sand sample

** 140# hammer, 30-inch drop

Relative density is also used to describe condition of low plasticity ($P \leq 10$) fine grained soils such as sandy silts.

FINE GRAINED SOILS

(Major portion passing No. 200 sieve)

Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests for soils with plasticity indices ≥ 10 .

Descriptive Term	Compressive Strength Tons/Sq. Ft.
Very soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very stiff	2.00 to 4.00
Hard	4.00 and higher

Note: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes and weakness or shrinkage cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

Fissured	- containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical	Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Sensitive	- pertaining to cohesive soils that are subject to appreciable loss of strength when remolded	Degree of slickenside development:	
Laminated	- composed of thin layers of varying color and texture	Slightly slickensided	- slickensides are present at intervals of 1-2 feet and soil does not easily break along these planes.
Interbedded	- composed of alternate layers of different soil types	Moderately slickensided	- slickensides are spaced at intervals of 1-2 feet and soil breaks easily along these planes.
Calcareous	- containing appreciable quantities of calcium carbonate	Extremely slickensided	- slickensides are spaced at intervals 4-12 inches, are continuous and interconnected. Soil breaks easily along the slickensides. Resulting size of broken pieces three to six inches.
Well graded	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes	Intensely slickensided	- slickensides are spaced at intervals of less than four inches and are continuous in all directions. Soil breaks down along planes into nodules 0.25 - 2 inch in size.
Poorly graded	- predominately of one grain size, or having a range of sizes with some intermediate size missing		

KEY TO ROCK CLASSIFICATIONS AND SYMBOLS

ROCK TYPE						SAMPLE TYPE				
						Undisturbed				
Claystone	Limestone	Dolomite	Chalk	Marl	Shale	Pitcher Barrel	Shelby Tube	Rock Core	Split Spoon	No Recovery
Siltstone	Sandstone	Conglomerate	Granite	Quartz	Anhydrite					

TERMS CHARACTERIZING PHYSICAL PROPERTIES OF ROCK

Bedding Characteristics:

- Massive** - occurring in thick beds, free from minor joints and laminations, more than 100 mm. in thickness
- Thin to med.** - occurring in relatively thin layers or laminae, 2 mm. to 100 mm. bedding planes
- Fissile** - bedding which consists of laminae less than 2 mm. in thickness, splits easily along closely spaced parallel planes
- Cross-bedded** - arrangement of laminations of strata transverse or oblique to the main planes of stratification of the strata concerned
- Foliated** - the laminated structure resulting from segregation of granular and fine minerals into layers parallel to the schistosity (result of the parallel arrangement of platy and ellipsoidal mineral grains)
- Platy** - parallel arrangement of broad or flat minerals (giving a foliation) by slablike inclusions, by schlieren, or by bands of different mineralogy or texture
- Fragmental** - consisting of broken material, particularly that which has been moved from its place of origin

Lithologic Characteristics:

- Clayey, Shaly,** - The lithology is used describing the parent rock such as a shaly limestone or carbonaceous shale
- Calcareous (limy)**
- Siliceous**
- Sandy, Silty,**
- Plastic Seams**
- Carbonaceous**

Hardness and Degree of Cementation:

- Very soft or plastic** - can be remolded in hand, corresponds in consistency up to very stiff in soils
- Soft** - can be scratched with fingernail
- Moderately hard** - can be scratched easily with knife; cannot be scratched with fingernail
- Hard** - difficult to scratch with knife
- Very hard** - cannot be scratched with knife
- Poorly cemented or friable** - easily crumbled
- Cemented** - bound together by chemically precipitated material occurring in the interstices between allochthonous particles of rock - quartz, calcite, dolomite, siderite and iron oxide are common cementing materials

Swelling Properties:

Swelling and Non-Swelling

Slaking Properties:

Non-Slaking

Slakes slowly on exposure

Slakes readily on exposure

Texture:

- Dense** - fine-grained ophanitic rocks in which the grain size generally averages less than 0.05 to 0.1 mm.
- Fine** - more than 50% by weight smaller than 0.074 mm. in diameter (seen only with a strong hand lens or a microscope)
- Medium** - majority of grain sizes between 0.074 mm. and 0.5 mm.
- Coarse** - grain sizes range from 0.5 mm. to 1.0 mm. (crystals are visible to the unaided eye)

Structure:

- Bedding** - Flat (0° to 15°); Gently dipping (15° to 30°); Steeply dipping (30° to vertical)
- Fractures, scattered or open** - broken surface of minerals or rock which does not exhibit cleavage or bedding planes
- Fractures, closely spaced** - shows signs of broken minerals but now is cemented
- Brecciated (sheared & fragmented)** - rock made up of highly angular coarse fragments - may be sedimentary or formed by crushing or grinding along faults
- Joints** - fractures in rock, generally more or less vertical or transverse to bedding, along which no appreciable movement has occurred.
- Faulted** - fracture or fracture zone along which there has been displacement of the sides relative to one another parallel to the fracture - the displacement may be a few inches or many miles
- Slickensides** - polished and striated (scratched) surface that results from friction along a fault plane

Degree of Weathering:

- Unweathered** - rock in its natural state before being exposed to atmospheric agents
- Slightly weathered** - noted predominantly by color change with no disintegrated zones
- Weathered** - complete color change with zones of slightly decomposed rock
- Extremely weathered** - complete color change with consistency, texture, and general appearance approaching soil

Solution and Void Conditions:

- Solid** - contains no voids
- Vuggy (pitted)** - cavities in rock
- Vesicular** - containing many small cavities
- Porous** - containing voids, pores, interstices, or other openings which may or may not interconnect
- Cavities** - solutional concavity in limestone caves, the outline of which is determined by a joint or joints - also applied to small hollows in cavernous lava
- Cavernous** - containing cavities or caverns, sometimes quite large - most frequent in limestones and dolomines

SUBURBAN LABORATORIES, Inc.

CHEMICAL ANALYSTS SINCE 1936

4140 LITT DRIVE • Phone 312/544-3260 • HILLSIDE, ILLINOIS 60162

Certifications: U.S.D.A. #1783 • Ill. Dept. of Public Health #17135 • Amer. Spice Trade Assn. • F.D.A. Reg. #50298 • Ill. EPA #100191

ANALYSIS REPORT

NO. 10736, 10737, 10738

A & H Flood Company
Attention: Mr. T. Ledone
4421 Harrison Street
Hillside, Illinois 60162

P.O. No. _____

Sample Recd. 9/19/84 Tests Completed 9/28/84**SAMPLE INFORMATION**Source 1st Sample -

#10736 - GNB Kankakee, B-5, 14', S-1

#10737 - GNB Kankakee, B-4, 7', S-2

#10738 - GNB Kankakee, B-6, 14', S-3

*
ppmSampling Method: By Client X By Sub. Lab. _____ Serco Auto-Sampler _____ Other _____**ANALYSIS**

	#10736	#10737	#10738		#10736	#10737	#10738
Total Solids mg/l				Nitrogen-Tot mg/l			
Fix. Tot. Sol. mg/l				Nitrogen-Amm mg/l			
Vol. Tot. Sol. mg/l				Nitrogen-Org mg/l			
Diss. Solids mg/l	1368	1208	2728	Nitrite mg/l			
Settle. Sol. ml/l				Nitrate-Nitro mg/l	3.80	1.15*	3.3
Tot. Sus. Sol. mg/l				Phosphate (Total) mg/l			
Fix. Sus. Sol. mg/l				Phosphate (Ortho) mg/l			
Vol. Sus. Sol. mg/l				Sulfate mg/l	614	237	1485
				Sulfide mg/l			
BOD mg/l				Sulfite mg/l			
COD mg/l				Aluminum mg/l			
DO mg/l				Antimony mg/l			
				Arsenic mg/l			
Phenols ug/l				Barium mg/l			
MBAS mg/l				Beryllium mg/l			
Oils & Greases mg/l				Boron mg/l			
				Cadmium mg/l			
Tot. Bact. Cells/100 ml				Calcium mg/l			
Tot. Coli. Cells/100 ml				Chrom-Total mg/l			
Fecal Coli. Cells/100 ml				Chrom-Hex. mg/l			
				Chrom-Tri. mg/l			
pH	6.3	6.8	6.7	Copper mg/l			
Spec. Cond. umhos/cm	1050	1750	2550	Iron mg/l			
Alkalinity mg/l as CaCO ₃				Lead mg/l	0.12	20.8	16.5
Acidity mg/l as CaCO ₃				Lithium mg/l			
Tot. Hard. mg/l as CaCO ₃				Magnesium mg/l			
Resid. Cl ₂ mg/l				Manganese mg/l			
Bromide mg/l				Mercury ug/l			
Chloride mg/l	51	365	101	Nickel mg/l			
Fluoride mg/l				Potassium mg/l			
Cyanide-Total mg/l				Silver mg/l			
Cyanide-Free mg/l				Sodium mg/l			
				Strontium mg/l			
				Tin mg/l			
				Zinc mg/l			

Our methods are in accordance with the American Public Health Association, Standard Methods 15th Edition

ANALYSIS CERTIFIED BY _____, Director

Date 9/28/84 ak

SUBURBAN LABORATORIES, Inc.

CHEMICAL ANALYSTS SINCE 1936

4140 LITT DRIVE • Phone 312/544-3260 • HILLSIDE, ILLINOIS 60162

Certifications: U.S.D.A. #1783 • Ill. Dept. of Public Health #17135 • Amer. Spice Trade Assn. • F.D.A. Reg. #50296 • Ill. EPA #100191

ANALYSIS REPORT

NO. 10739, 10740, 10741

CLIENT

A & H Flood Company
Attention: Mr. T. Ledone
4421 Harrison Street
Hillside, Illinois 60162

P.O. No. _____

Sample Recd. 9/19/84 Tests Completed 9/28/84**SAMPLE INFORMATION**Source 1st Sample - GNB - Kankakee

#10739 - B-9, 10' S-4

* ppm

** HGA

#10740 - B-11, 22', S-5

#10741 - B-14, 14', S-6

Sampling Method: By Client X By Sub. Lab. _____ Serco Auto-Sampler _____ Other _____**ANALYSIS**

	#10739	#10740	#10741		#10739	#10740	#10741
Total Solids mg/l				Nitrogen-Tot mg/l			
Fix. Tot. Sol. mg/l				Nitrogen-Amm mg/l			
Vol. Tot. Sol. mg/l				Nitrogen-Org mg/l			
Diss. Solids mg/l	1808	660	1296	Nitrite mg/l			
Settle. Sol. ml/l				Nitrate - Nitro mg/l	1.45*	6.08	0.18
Tot. Sus. Sol. mg/l				Phosphate (Total) mg/l			
Fix. Sus. Sol. mg/l				Phosphate (Ortho) mg/l			
Vol. Sus. Sol. mg/l				Sulfate mg/l	392	123	117
BOD mg/l				Sulfide mg/l			
COD mg/l				Sulfite mg/l			
DO mg/l				Aluminum mg/l			
Phenols ug/l				Antimony mg/l			
MBAS mg/l				Arsenic mg/l			
Oils & Greases mg/l				Barium mg/l			
Tot. Bact. Cells/100 ml				Beryllium mg/l			
Tot. Coli. Cells/100 ml				Boron mg/l			
Fecal Coli. Cells/100 ml				Cadmium mg/l			
pH	7.0	7.1	7.4	Calcium mg/l			
Spec. Cond. umhos/cm	1800	750	1050	Chrom-Total mg/l			
Alkalinity mg/l as CaCO ₃				Chrom-Hex. mg/l			
Acidity mg/l as CaCO ₃				Chrom-Tri. mg/l			
Tot. Hard. mg/l as CaCO ₃				Copper mg/l			
Resid. Cl ₂ mg/l				Iron mg/l			
Bromide mg/l				Lead mg/l	9.5	0.45	0.003**
Chloride mg/l	260	46	304	Lithium mg/l			
Fluoride mg/l				Magnesium mg/l			
Cyanide-Total mg/l				Manganese mg/l			
Cyanide-Free mg/l				Mercury ug/l			
				Nickel mg/l			
				Potassium mg/l			
				Silver mg/l			
				Sodium mg/l			
				Strontium mg/l			
				Tin mg/l			
				Zinc mg/l			

Our methods are in accordance with the American Public Health Association, Standard Methods 15th Edition.

ANALYSIS CERTIFIED BY: [Signature] DirectorRetyped 10/3/84 ak
Date: _____

PLATE 24

CLIENT COPY

SUBURBAN LABORATORIES, Inc.

CHEMICAL ANALYSTS SINCE 1936

4140 LITT DRIVE • Phone 312/544-3260 • HILLSIDE, ILLINOIS 60162

Certifications: U.S.D.A. #1783 • Ill. Dept. of Public Health #17135 • Amer. Spice Trade Assn. • F.D.A. Reg. #50298 • Ill. EPA #100191

ANALYSIS REPORT

NO. 10742, 10743

CLIENT

A & H Flood Company
Attention: Mr. T. Ledone
4421 Harrison Street
Hillside, Illinois 60162

P.O. No. _____

Sample Recd. 9/19/84 Tests Completed 9/28/84

SAMPLE INFORMATION

Source 1st Sample - GNB Kankakee

#10742 - B-15, 20.5', S-7

#10743 - B-17, 5', S-8

**
by HGASampling Method: By Client ☒ By Sub. Lab. _____ Serco Auto-Sampler _____ Other _____**ANALYSIS**

	#10742	#10743			#10742	#10743	
Total Solids mg/l				Nitrogen-Tot mg/l			
Fix. Tot. Sol. mg/l				Nitrogen-Amm mg/l			
Vol. Tot. Sol. mg/l				Nitrogen-Org mg/l			
Diss. Solids mg/l	640	1084		Nitrite mg/l			
Settle. Sol. ml/l				Nitrate-Nitro mg/l	0.10	1.25	
Tot. Sus. Sol. mg/l				Phosphate (Total) mg/l			
Fix. Sus. Sol. mg/l				Phosphate (Ortho) mg/l			
Vol. Sus. Sol. mg/l				Sulfate mg/l	156	188	
				Sulfide mg/l			
BOD mg/l				Sulfite mg/l			
COD mg/l				Aluminum mg/l			
DO mg/l				Antimony mg/l			
				Arsenic mg/l			
Phenols ug/l				Barium mg/l			
MBAS mg/l				Beryllium mg/l			
Oils & Greases mg/l				Boron mg/l			
				Cadmium mg/l			
Tot. Bact. Cells/100 ml				Calcium mg/l			
Tot. Coli. Cells/100 ml				Chrom-Total mg/l			
Fecal Coli. Cells/100 ml				Chrom-Hex. mg/l			
				Chrom-Tri. mg/l			
pH	7.1	7.3		Copper mg/l			
Spec. Cond. umhos/cm	700	1250		Iron mg/l			
Alkalinity mg/l as CaCO ₃				Lead mg/l	/ 0.001**	/ 0.001**	
Acidity mg/l as CaCO ₃				Lithium mg/l			
Tot. Hard. mg/l as CaCO ₃				Magnesium mg/l			
Resid. Cl ₂ mg/l				Manganese mg/l			
Bromide mg/l				Mercury ug/l			
Chloride mg/l	61	167		Nickel mg/l			
Fluoride mg/l				Potassium mg/l			
Cyanide- Total mg/l				Silver mg/l			
Cyanide-Free mg/l				Sodium mg/l			
				Strontium mg/l			
				Tin mg/l			
				Zinc mg/l			

Our methods are in accordance with the American Public Health Association, Standard Methods 15th Edition.

ANALYSIS CERTIFIED BY: _____ Director

Retyped
Date: 10/3/84 ak

PLATE 25

CLIENT COPY

SUBURBAN LABORATORIES, Inc.

4140 LITT DRIVE

HILLSIDE, ILLINOIS 60162 - 1183

EARL I. ROSENBERG
President

September 17, 1984

H.R. THOMAS, JR.
DirectorA & H Flood Company
4421 Harrison Street
Hillside, Illinois 60162

Attention: Mr. T. Ledone

<u>Samples Received:</u> 8/31/84	<u>Total Lead (ppm)</u>	<u>E. P. Toxicity Lead (mg/l)</u>
#10050 - Boring #B-1, Depth 2.5')Kankakee	91.5	/ 0.10
#10051 - Boring #B-1, Depth 4.5')Kankadee	71.5	/ 0.10
#10052 - Boring #B-2, Depth 2.5'	188	/ 0.10
#10053 - Boring #B-2, Depth 5.0'	74.5	/ 0.10
#10054 - Boring #B-2, Depth 10'	35.5	/ 0.10
#10055 - Boring #B-3, Depth 2.5'	40.6	/ 0.10
#10056 - Boring #B-3, Depth 5.0'	35.7	/ 0.10
#10057 - Boring #B-3, Depth 10'	32.9	/ 0.10
#10058 - Boring #B-4, Depth 2.5'	326	/ 0.10
#10059 - Boring #B-4, Depth 5.0'	51.0	/ 0.10
#10060 - Boring #B-7, Depth 2.5'	3000	3.06
#10061 - Boring #B-7, Depth 5'	192	0.28
#10062 - Boring #B-8, Depth 2½'	86.5	0.21
#10063 - Boring #B-8, Depth 5'	188	0.25
#10064 - Boring #B-9, Depth 2.5'	1540	0.35
#10065 - Boring #B-9, Depth 5.0'	770	2.76
#10066 - Boring #B-9, Depth 10'	175	1.46
#10067 - Boring #B-10, Depth 2½'	36000	24.8
#10068 - Boring #B-10, Depth 5.0'	1940	1.75
#10069 - Boring #B-12, Depth 2.5'	2260	1.65
#10070 - Boring #B-12, Depth 5.0'	133	0.50
#10071 - Boring #B-13, Depth 2.5')Kankakee	39.2	0.15
#10072 - Boring #B-13, Depth 4.5')Kankakee	40.9	/ 0.10
#10073 - Boring #B-14, Depth 2.5')Kankakee	133	/ 0.10
#10074 - Boring #B-14, Depth 5.0')Kankakee	58.0	/ 0.10
#10075 - Boring #B-14, Depth 10'	48.6	/ 0.10
#10076 - Boring #B-16, Depth 2.5')Kankakee	13.1	/ 0.10
#10077 - Boring #B-16, Depth 4.5')Kankakee	31.5	0.14
#10078 - Boring #B-16, Depth 10'	30.9	/ 0.10
#10079 - Boring #B-17, Depth 2.5')Kankakee	44.5	/ 0.10
#10080 - Boring #B-17, Depth 4.5')Kankakee	34.4	0.14
#10081 - Boring #B-17, Depth 10'	40.5	0.16

(Continued)

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Water Pollution Control Federation • Institute of Food Technology

Certifications: U.S.D.A. #1783 • Ill. Dept. of Public Health #17135 • Amer. Spice Trade Assn. • F.D.A. Reg. #50296 • Ill. EPA #100191

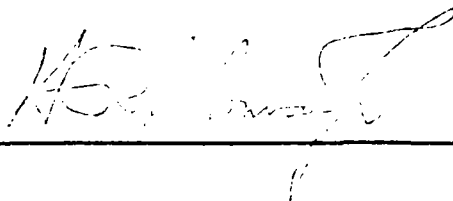
SEP 17 1984

A & H FLOOD EN

A & H Flood Company
September 17, 1984
Page #2

<u>Samples Received:</u> <u>8/31/84</u>	<u>Total</u> <u>Lead (ppm)</u>	<u>E. P. Toxicity</u> <u>Lead (mg/l)</u>
#10082 - Boring #B-18, Depth 2.5')Kankakee	14.2	/ 0.10
#10083 - Boring #B-18, Depth 4.5')Kankakee	22.5	- 0.16

ANALYSIS CERTIFIED BY:



, Director (HRT:ih)

SUBURBAN LABORATORIES, Inc.

4140 LITT DRIVE

HILLSIDE, ILLINOIS 60162 - 1183

EARL I. ROSENBERG
President

September 28, 1984

H.R. THOMAS, JR.
DirectorA & H Flood Company
4421 Harrison Street
Hillside, Illinois 60162

Attention: Mr. T. Ladone

	Total Lead (ppm)	<u>E. P. Toxicity</u> Lead (mg/l)
<u>Samples Received:</u> 9/17/84		
<u>Project #GNB</u>		
S/L #10603 - Boring #5, Depth 2½'	626	/ 0.10
S/L #10604 - Boring #5, Depth 5.0'	32.0	/ 0.10
S/L #10605 - Boring #5, Depth 10.0'	56.0	/ 0.10
S/L #10606 - Boring #6, Depth 2½'	12960	0.60
S/L #10607 - Boring #6, Depth 5.0'	7360	44.6
S/L #10608 - Boring #6, Depth 10.0'	1460	22.6
S/L #10609 - Boring #11, Depth 2½'	11800	26.8
S/L #10610 - Boring #11, Depth 5.0'	712	0.61
S/L #10611 - Boring #11, Depth 10.0'	766	1.49
S/L #10612 - Boring #15, Depth 2½'	35.6	0.15
S/L #10613 - Boring #15, Depth 5.0'	14.5	/ 0.10
S/L #10614 - Boring #15, Depth 10.0'	34.5	/ 0.10

(/ = less than)



ANALYSIS CERTIFIED BY: _____, Director(HRT/ak)

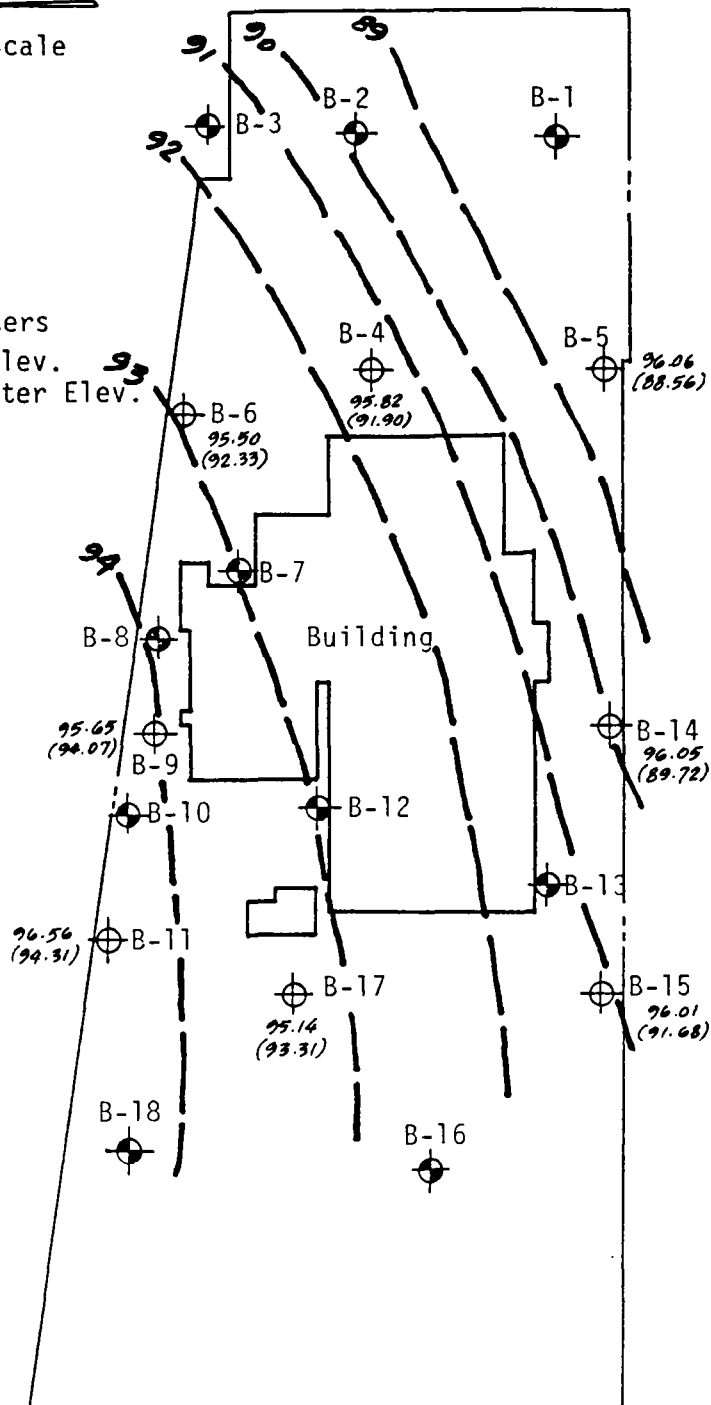
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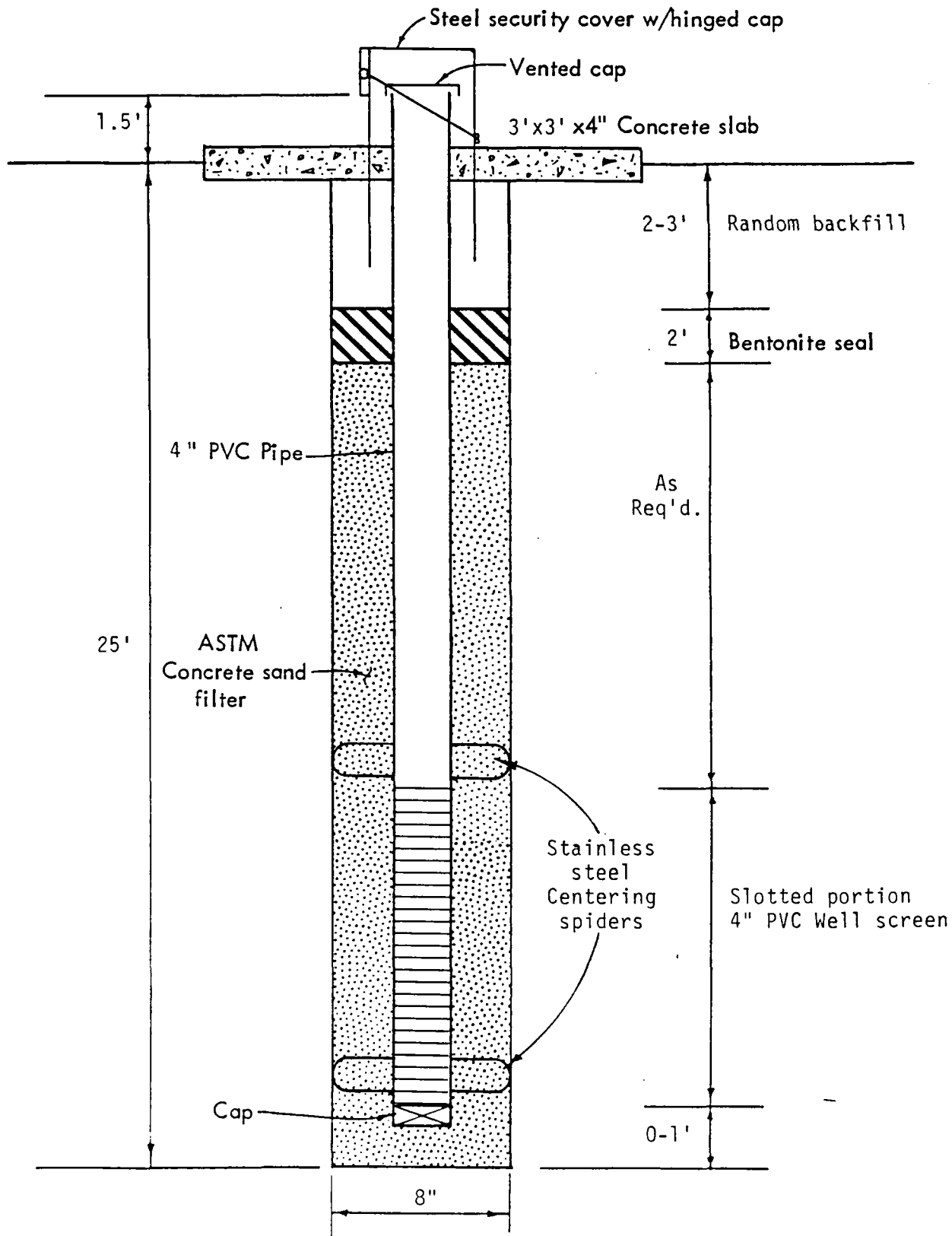
Not to Scale

Legend

-  Borings
-  Piezometers
- Ground Elev.
- Groundwater Elev.



INTERPRETATION OF
GROUNDWATER CONTOURS



TYPICAL
MONITOR WELL DETAIL

SUMMARY OF RESULTS
FIELD PACKER TESTS

<u>Boring No.</u>	<u>Description of Formation</u>	<u>Depth of Test(ft)</u>	<u>Flow Rate (gpm)</u>		<u>Permeability (cm/sec)</u>
			<u>Initial</u>	<u>Constant</u>	
B-5	Weathered limestone	19.0-22.0	7.0	7.0	6.27×10^{-4}
B-6	Unweathered limestone	19.0-22.0	1.8	5.0	4.66×10^{-4}
B-11	Weathered limestone	23.5-26.5	0.2	0.3	2.77×10^{-5}
B-15	Weathered limestone	22.8-25.8	0	0	Impermeable

A P P E N D I X

FIELD AND LABORATORY PROCEDURES

Standard field drilling and sampling procedures and laboratory testing procedures are described in the following paragraphs.

Field Drilling and Sampling

Borings are advanced in soil formations by either auger or wash drilling methods. Soil samples are obtained at the designated sampling intervals using the following sampling techniques:

1. Undisturbed Samples

A. Shelby Tube Samples

The Shelby tube sampler is a three-inch-diameter (O.D.), thin-walled steel tube which is primarily used to obtain undisturbed samples of cohesive soils into which the tube can be pushed by the hydraulic pulldown and weight of the drill rig. Shelby tube sampling procedures are in general accordance with ASTM Method D-1587. Recovered Shelby tube samples are extruded in the field, logged, separated horizontally into 0.4-foot-long segments and, finally, sealed airtight with wax in quart containers.

B. Pitcher Barrel Samples

The Pitcher barrel sampler is used to obtain undisturbed samples of hard clays, dense to very dense silty or clayey fine sands, and very soft rocks which are too hard to be sampled with a Shelby tube sampler. The Pitcher barrel sampler is a double-tube core barrel, with the inner barrel being a three-inch-diameter (O.D.), thin-walled, steel tube which leads the cutting bit. The inner tube is advanced by pressure from a heavy internal spring that is compressed under the constant hydraulic pressure from the drilling rig. Thus, the lead of the inner barrel varies over that of the outer barrel with the consistency of the material encountered. Recovered Pitcher barrel samples are extruded in the field, logged, separated horizontally into 0.4-foot-long segments and, finally, sealed airtight with wax in quart containers.

The consistency of undisturbed cohesive soil samples is evaluated in the field using a calibrated hand penetrometer. This device measures the pressure necessary to push a 0.25-inch-diameter piston into the undisturbed specimen. The pressure at 0.25-inch penetration has been

correlated with the laboratory unconfined compressive strength; thus, a representative estimate of soil consistency is obtained. The results, expressed in terms of shear strength (one-half the compressive strength), are plotted as open circles in the strength graph on the boring logs. A plus sign (+) accompanying the open circle indicates that the shear strength exceeds 1.5 tsf, which is the capacity of the penetrometer.

2. Disturbed Samples

A. Split-Barrel Samples (Standard Penetration Test)

Disturbed samples of cohesionless soils are obtained using a two-inch-diameter (O.D.) split-barrel sampler and the standard penetration test. Split-barrel sampling is performed in general accordance with ASTM Method D-1586. The split-barrel sampler is driven 18 inches into the bottom of the borehole by a 140-pound hammer freely falling 30 inches. The number of blows is recorded for each of three six-inch increments of penetration. The sum of the blows for the final foot of penetration is termed the standard penetration resistance ("N" value) which is expressed in blows per foot and tabulated on the boring logs at the depths the sampler was used. Recovered soil samples are placed in pint-sized glass jars.

B. Auger Samples

Disturbed soil samples are obtained from soil cuttings brought to the ground surface while advancing a boring with six-inch-diameter, continuous-flight augers. The recovered soil samples are sealed in quart-sized glass jars. In addition, bulk samples, usually weighing 50 to 75 pounds, are obtained at selected auger boring locations to provide a sufficient quantity of soil for performing laboratory tests on remolded specimens.

In instances where coring is necessary to advance borings through rock formations, rock coring is performed using an NX double-tube core barrel equipped with a tungsten carbide or diamond drill bit. The diameter of the recovered rock cores ranges from 1.875 inches (NX wire line size) to 2.125 inches (standard NX size), depending upon the particular type of NX core barrel employed. Rock cores are sealed in plastic and placed in either cardboard or wooden core boxes. The amount of core recovered, expressed as a percentage of the coring interval, is tabulated at the respective depths on the boring logs.

Laboratory Tests

Laboratory tests are performed using the following testing procedures:

1. Classification Tests

Field classification of soil samples and rock cores is verified in the laboratory through visual classification of samples by a geotechnical engineer or geologist. Samples are classified according to color, texture, predominant material type, and consistency (if soil) or hardness (if rock).

Laboratory tests are performed on representative soil samples to determine natural moisture content, liquid and plastic limits, and percent passing the No. 200 sieve. These tests are performed in general accordance with ASTM Methods D-2216, D-423, D-424 and D-422, respectively. Classification test results are tabulated at the corresponding sample depths on the boring logs and are also shown on the generalized soil profiles.

Both the soil classification test results and the visual soil classifications are used to determine the Unified Soil Classification System symbol(s) for each generalized soil stratum. These symbols are shown on the boring logs at the lower right corner of each stratum under the heading "Soil Description." Procedures for determining the Unified Soil Classification are in accordance with ASTM Method D-2487.

2. Unconfined Compression Tests

Unconfined compression tests are performed on undisturbed cohesive soil specimens trimmed from samples extruded from Shelby tubes or Pitcher barrel tubes. In this test, a cylindrical specimen having a height-to-diameter ratio of approximately 2.0 is subjected to an axial load without lateral confinement. The axial load is applied at a uniform strain rate of 0.025 inch per minute until the peak compressive stress is reached. The shear strength is equal to one-half the peak compressive stress. Shear strengths determined from these tests are plotted as solid circles in the strength plot on the boring logs at the corresponding sample depth. The natural moisture content and dry density of each specimen are recorded opposite the strength values. The shear strength results determined from unconfined compression tests are also shown on the generalized soil profiles.

Unconfined compression tests are also performed on intact rock core specimens in accordance with ASTM Method D-2938. Test results are reported as indicated in the preceding paragraph.

3. Confined Compression Tests

Confined compression tests are performed on undisturbed soil specimens trimmed from samples extruded from Shelby tubes and Pitcher barrel tubes. The height-to-diameter ratio of the specimens is about 2.0. A confining pressure, equal to the effective overburden pressure, is applied without allowing drainage of the specimen. Use of the confining pressure is intended to prevent premature failure of the specimen during loading due to slickensides, unconsolidated silt or sand lenses, etc. Following application of the confining pressure, the specimen is subjected to an axial load which is applied at a uniform strain rate of about 0.025 inch per minute until the peak deviator stress (i.e., the difference between the major and minor principal stresses) is reached. The shear strength is equal to one-half the peak deviator stress. Shear strengths determined from these tests are plotted as solid triangles in the strength plot on the boring logs. The natural moisture content and dry density of each specimen are recorded opposite the strength values. The shear strength results determined from confined compression tests are also shown on the generalized soil profiles.

4. Triaxial Compression Tests (Unconsolidated-Undrained)

Unconsolidated-undrained triaxial compression tests are performed on 2.8-inch-diameter specimens prepared from either undisturbed Shelby tube and Pitcher barrel tube samples or else from remolded samples. The height-to-diameter ratio of the specimens is about 2.0. Generally, undisturbed soil specimens are tested under saturated conditions. If back pressure is used to help saturate the specimens, saturation is considered complete when the ratio between the increase in back pressure to the increase in chamber pressure is 0.95 or greater. Remolded specimens representing soils to be placed and compacted in embankments are normally tested at their expected initial in-situ degree of saturation. In this test, a confining pressure is initially applied to the specimen. No drainage is allowed after application of the confining pressure nor during axial compression. Axial loading is applied at a constant strain rate of about 0.025 inch per minute until the peak deviator stress (i.e., the difference between the major and minor principal stresses) is reached. Compressive strength is determined for a minimum of three net confining pressures using separate specimens for remolded soil and a single specimen for undisturbed soil. Use of a single specimen is referred to as multi-stage loading. A plot of shear strength, as a function of normal pressure, defines the angle of internal shear, ϕ , and cohesion, c , (shear strength at zero confining pressure).

5. Triaxial Compression Tests (Consolidated-Undrained without Pore Pressure Measurements)

Consolidated-undrained triaxial compression tests are performed on 2.8-inch-diameter specimens prepared from either undisturbed Shelby tube and Pitcher barrel tube samples or else from remolded samples. The height-to-diameter ratio of the specimens is about 2.0. In this test, a confining pressure is initially applied to the specimen. Drainage is permitted to allow the specimen to be tested in a saturated condition. If back pressure is used to help saturate the specimen, saturation is considered complete when the ratio between the increase in back pressure to the increase in chamber pressure is 0.95 or greater. No drainage is allowed during axial compression. Axial loading is applied at a constant strain rate of about 0.025 inch per minute until the peak deviator stress (i.e., the difference between the major and minor principal stresses) is reached. Compressive strength is determined for a minimum of three net confining pressures using separate specimens for remolded soil and a single specimen for undisturbed soil. Use of a single specimen is referred to as multi-stage loading. A plot of shear strength, as a function of normal pressure, defines the angle of internal shear, ϕ , and cohesion, c , (shear strength at zero confining pressure).

6. Triaxial Compression Tests (Consolidated-Undrained with Pore Pressure Measurements)

Consolidated-undrained triaxial compression tests with pore pressure measurements are performed on 2.8-inch-diameter specimens prepared from either undisturbed Shelby tube and Pitcher barrel tube samples or else from remolded samples. The height-to-diameter ratio of the specimens is about 2.0. In this test, a confining pressure is initially applied to the specimen. Drainage is permitted to allow the specimen to be tested in a saturated condition. If back pressure is used to help saturate the specimen, saturation is considered complete when the ratio between the increase in back pressure to the increase in chamber pressure is 0.95 or greater.

No drainage is allowed during axial compression. Axial loading is applied at a constant strain rate of about 0.025 inch per minute until the peak ratio of effective principal stresses is reached. Pore pressures during axial loading are read using an electrical transducer. Compressive strength is determined for a minimum of three net confining pressures using separate specimens for remolded soil and a single specimen for undisturbed soil. Use of a single specimen is referred to as multi-stage loading. A plot of shear strength, as a function of normal pressure, defines the angle of internal shear, ϕ , and cohesion, c , (shear strength at zero confining pressure). Plots are presented for both the total and effective strength envelopes.

7. Direct-Shear Tests (Consolidated-Drained)

Consolidated-drained direct shear tests are performed on specimens trimmed from either undisturbed samples or remolded samples to define strength parameters corresponding to the drained or effective stress condition. In this test, a specimen (0.75-inch thick and 2.5 inches in diameter) is subjected to a normal stress, inundated, and allowed to consolidate. Horizontal shearing loads are then applied at a sufficiently slow rate (approximately 1.5×10^{-4} in/min) to ensure that complete drainage of the specimen occurs during shear. Three different values of normal stress are applied to three separate specimens and the maximum shearing strength is measured for each normal stress. After initial shear, the peak strength is defined and the specimens are repeatedly sheared to define the minimum or residual strength. A plot of shearing strength, as a function of normal stress, defines the angle of internal friction, ϕ , and cohesion, c , of the specimen for both the initial and residual shear strengths.

8. Consolidation Tests

One-dimensional consolidation tests are performed on representative specimens taken from either undisturbed soil samples or remolded soil samples to define compressibility characteristics. In this test, the specimen (0.50 inch thick and 2.5 inches in diameter) is laterally confined, inundated, and subjected to increasing values of normal stress. The change in height for each normal stress is observed as a function of time. Test procedures follow criteria outlined by ASTM Method D-2435.

Results of the consolidation tests are summarized on the individual test reports. The solid line on the consolidation plots shows the void ratio of the specimen as a function of vertical pressure. The lower dashed line represents the coefficient of consolidation, C_v , in $\text{cm/sec} \times 10^{-4}$ plotted against vertical pressure. The classification properties for each consolidation specimen are also shown.

9. Swell Tests

The potential swelling characteristics of the foundation clays are evaluated by swell tests performed on undisturbed samples. In this test, the specimen may be initially air-dried to near its plastic limit, or tested at in-situ moisture conditions, placed in a consolidometer, and then loaded to present overburden pressure until equilibrium is reached. The specimen is then inundated and permitted to absorb moisture. Volumetric equilibrium is maintained by increasing the pressure until a balance point is obtained. The specimen is then unloaded and permitted to absorb moisture and swell. The results of these tests, together with pertinent physical characteristics, are presented on the individual test reports.

10. Falling-Head Permeability Tests

Seepage characteristics of undisturbed or remolded cohesive soil samples are defined by falling-head permeability tests. In this test, a 2.5-inch-diameter, 0.75-inch-thick specimen is placed in a fixed-ring permeameter. The specimen is placed under a constant hydraulic head until saturated. Then, the hydraulic head is allowed to drop, with periodic readings being taken to record the rate of fall. The coefficient of permeability for the specimen is calculated based on the observed rate of fall. Falling-head permeability test procedures follow those outlined in Manual No. EM-1110-2-1906 of the United States Army Corps of Engineers. Permeability coefficient values are tabulated on the boring logs at the corresponding sample depth and are also shown on the generalized soil profiles.